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(54) Eyetrack-driven illumination and information display

(57) An eyetracker is used to control power to an electrical device such as a computer display screen so that power consumption is reduced when a user's eyes and therefore a user's attention are not directed to the device. A motion detector activates a proximity detector and/or an IR detector to ensure that power is applied only when a user is actually present.

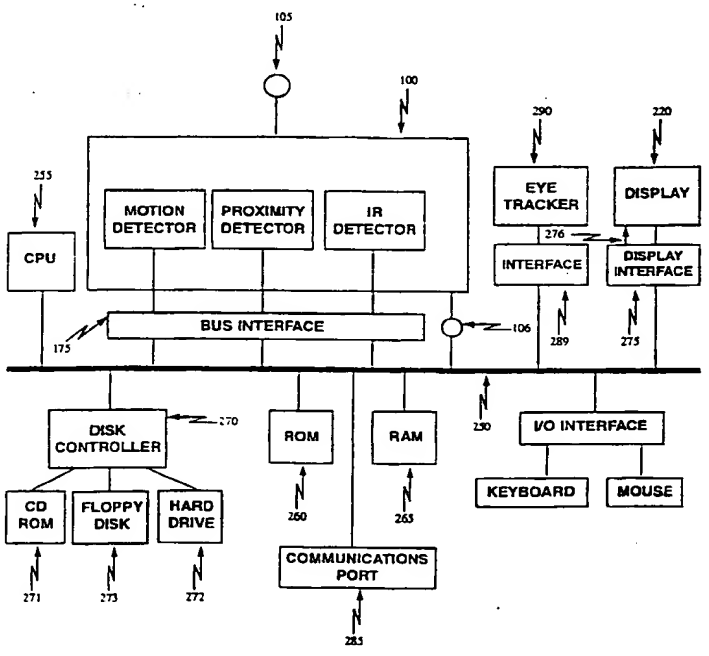

Figure 2B

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for a predetermined time interval or when the user's eyes fix on a particular point on the screen. Alternatively, the intensity level can be reestablished when the user's eyes begin to move toward the display. Power to the eyetracker is removed when the user has not looked at the display for a predetermined period of time.

The invention also relates to a method for automatically applying power to an electrical device, by detecting motion, by detecting proximity of objects to the device; and by applying power to the device when an object is within a predetermined distance from the electrical device within a predetermined period of time after motion has been detected.

The invention also relates to a method of controlling intensity of images on a display, by detecting where a user's eyes are looking and by changing intensity of images on the display based on where a user's eyes are looking.

The invention is also directed to a computer system including a network, a plurality of computers connected to the network, one of which is a computer equipped with a motion detector a proximity detector activated by the motion detector detecting motion; and a switch connected to a source of power and to the electrical device and controlled by the motion detector and the proximity detector for applying power to the at least a particular one of the plurality of computers when the proximity detector detects an object within a predetermined distance from the computer.

The invention is also directed to computer program products each including a memory medium and containing one or more computer programs and data used to implement the above methods, apparatus and systems.

Still other objects and advantages of the present invention will become readily apparent to those skilled in the art from the following detailed description, wherein only the preferred embodiment of the invention is shown and described, simply by way of illustration of the best mode contemplated of carrying out the invention. As will be realized, the invention is capable of other and different embodiments, and its several details are capable of modifications in various obvious respects, all without departing from the invention. Accordingly, the drawing and description are to be regarded as illustrative in nature, and not as restrictive.

BRIEF DESCRIPTION OF DRAWINGS

The objects, features and advantages of the system of the present invention will be apparent from the following description in which:

Figure 1 illustrates apparatus for automatically powering up and powering down an electrical device having an optional interface to a computer bus.

Figure 2A is an illustration of a computer which is selectively battery operated and suitable for use with the invention.

Figure 2B is an illustration of an exemplary computer architecture incorporating the invention.

Figure 2C is an illustration of an exemplary memory medium used to store computer programs and data of the invention.

Figure 3 is a state transition diagram of a computer process used in accordance with the invention.

Figure 4 is a state transition diagram of a power save process shown in **Figure 3.**

Figure 5 is a flow chart of a power down process shown in **Figure 3.**

Figure 6 is a flow chart of one power control process used as part of the invention.

Figure 7 is a flow chart of another power control process used in accordance with the invention.

NOTATIONS AND NOMENCLATURE

The detailed descriptions which follow may be presented in terms of program procedures executed on a computer or network of computers. These procedural descriptions and representations are the means used by those skilled in the art to most effectively convey the substance of their work to others skilled in the art.

A procedure is here, and generally, conceived to be a self-consistent sequence of steps leading to a desired result. These steps are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared, and otherwise manipulated. It proves convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like. It should be noted, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities.

Further, the manipulations performed are often referred to in terms, such as adding or comparing, which are commonly associated with mental operations performed by a human operator. No such capability of a human operator is necessary, or desirable in most cases, in any of the operations described herein which form part of the present invention; the operations are machine operations. Useful machines for performing the operation of the present invention include general purpose digital computers or similar devices.

The present invention also relates to apparatus for performing these operations. This apparatus may be specially constructed for the required purpose or it may comprise a general purpose computer as selectively activated or reconfigured by a computer program stored in the computer. The procedures presented herein are not inherently related to a particular computer or other apparatus. Various general purpose machines may be used with programs written in accordance with the teachings herein, or it may prove more convenient to construct more specialized apparatus to perform the re-

control processes used in accordance with the invention. The process begins with a power save state **310** which is described more in detail in **Figure 4.** From the power save state, the state can transition either to a power-up state **320** or return to itself. From power-up state **320,** the invention can transition to a power-down state shown more in detail in **Figure 5 (330)** or return to itself.

Turning to **Figure 4,** if motion detector **110** shown in Figure 1 detects motion **(410),** the proximity detector and the IR detector are activated **(420).** If they are both activated, then a check is made to determine if proximity of the object whose motion is detected is less than the threshold **(430)** and then a check made to see if the IR level is greater than a threshold **(440).** If it is, switch 145 shown in **Figure 1** is closed and power is applied to terminal **106** to power-up the external device thus entering the power-up state **320** shown in **Figure 3.** States **430** and **440** can transition to "set timer" state **450** if their conditions are not met. After timer **450** times out, it will transition to state **460** where the proximity detector and the IR detectors will be deactivated. State **460** will transition back to state **410** and the process begin again. State **460** may also be entered externally from the power-down state **330** shown in **Figure 3.**

Figure 5 shows more in detail the power-down state transition diagram **330** of **Figure 3.** When entered from the power-up state **320** of **Figure 3,** a set timer state **520** is entered which corresponds to power-down timer **150** shown in **Figure 1.** If motion is detected (state **530)** timer **520** is reset. If no motion is detected, state **540** results from a timeout which triggers a power-down device state **550.** This corresponds to resetting of flip-flops **140** and **115** if **Figure 1.** State **550** transitions back to power save state **300** shown in **Figure 3** and more specifically to state **460** within that state.

Figure 6 is a flow chart of a one power control process used as part of the invention. Eyetracker **290,** shown in **Figure 2B** is utilized to control the illumination of images on the display **220.** How this is done is shown in **Figure 6.** The eyetracker outputs are processed to distinguish four conditions shown in **Figure 6,** namely:

1. Whether the eyes are fixed at a point on the screen,
2. Whether the eyes move off the screen,
3. Whether the eyes are approaching the screen from a position off the screen, and
4. Whether the eyes are moving across the screen.

These four cases are distinguished by separate processing branches shown in **Figure 6.** When the eyetracker determines that the eyes are fixed on the screen, case 1 **(610)** obtains and the display intensity is set at normal illumination **(615).**

In case number 2 **(620),** when the eyes move from the screen to a point off the screen, a time interval of, preferably, 1/10 of a second **(625)** is set. If that time expires without the eyes returning to the screen, the screen will slowly fade the display intensity to black **(626).** In the embodiment shown in **Figure 6,** once the eyes have been off the screen for a period of time greater than the time set in item **625,** cases 3 and 4 are treated identically. That is, whether the eyes are approaching the screen or moving across the screen without fixing on the screen, the display intensity will resume normal illumination as quickly as possible. Normal illumination will thus continue until such time as the eyes leave the screen again.

The embodiment shown in **Figure 7,** is identical for cases 1 and 2 as that shown in **Figure 6.** However, cases 3 and 4 are treated separately. In case 3, where the eyes are approaching the on-screen condition, in this embodiment, nothing happens. That is, the screen remains blank. However, case 4 results in measurement of the time that the eyes are on the screen. If the time the eyes are on the screen exceeds some threshold, the display intensity is resumed at normal illumination as quickly as possible.

Thus, in accordance with the invention, electrical devices powered by energy sources of finite capacity can utilize the energy available to the maximum extent possible and reduce energy waste to a minimum.

In this disclosure, there is shown and described only the preferred embodiment of the invention, but, as aforementioned, it is to be understood that the invention is capable of use in various other combinations and environments and is capable of changes or modifications within the scope of the inventive concept as expressed herein.

Claims

1. Apparatus for automatically applying power to an electrical device, comprising:

   a. a motion detector;
   b. a proximity detector, activated by said motion detector detecting motion;
   c. a switch connected to a source of power and to said electrical device and controlled by said motion detector and said proximity detector for applying power to said electrical device when the proximity detector detects an object within a predetermined distance from the electrical device while activated by said motion detector.

2. The apparatus of claim 1, further including a power off timer, activated when power is applied to said electrical device and reset by said motion detector detecting motion for controlling said switch to remove power from said electrical device when the timer times out.

3. The apparatus of claim 1, in which said electrical

c.2. a proximity detector, activated by said motion detector detecting motion; and
c.3. a switch connected to a source of power and to said electrical device and controlled by said motion detector and said proximity detector for applying power to said at least a particular one of said plurality of computers when the proximity detector detects an object within a predetermined distance from the said at least a particular one of said plurality of computers while activated by said motion detector.

21. A computer program product for implementing intensity control of a computer display, comprising:

a. a computer readable memory medium; and
b. a computer program including

b.1. instructions for detecting where a user's eyes are looking; and
b.2. instructions for changing intensity of images on said display based on where a user's eyes are looking.

22. The computer program product of claim 21 in which the computer program further includes instructions for gradually reducing the intensity of images from a preexisting level to zero when a user's eyes are looking at a point off the display.

23. The computer program product of claim 21 in which the computer program further includes instructions for restoring said preexisting level when a users eyes look at a point on said display.

24. A computer program product for applying power to an electrical device, comprising:

a. a computer readable memory medium; and
b. a computer program including:

b.1 instructions for detecting motion;
b.2 instructions for detecting proximity of objects to said device; and
b.3 instructions for applying power to said device when an object is within a predetermined distance from the electrical device within a predetermined period of time after motion has been detected.

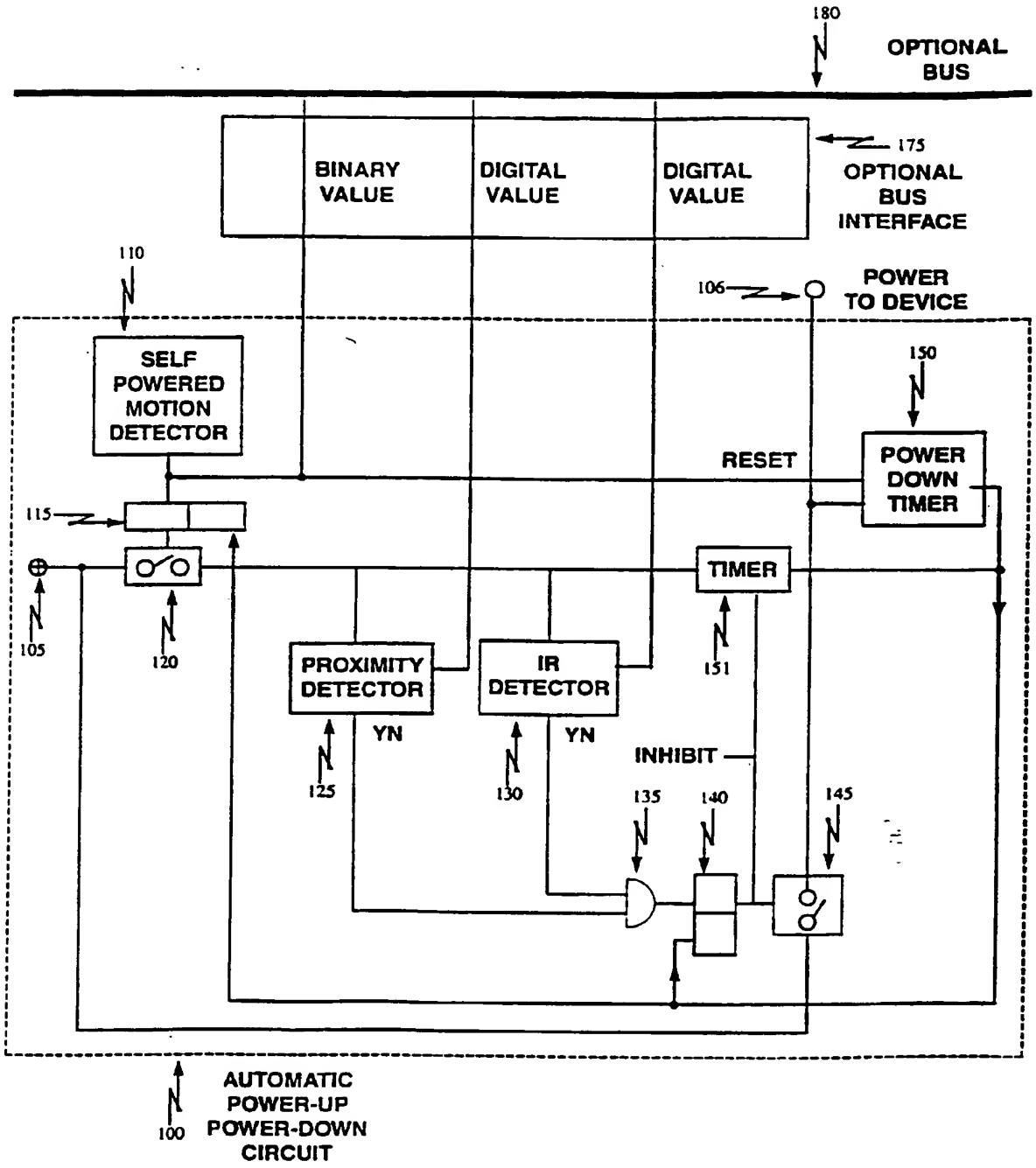
180
OPTIONAL BUS
BINARY VALUE
DIGITAL VALUE
DIGITAL VALUE
175
OPTIONAL BUS INTERFACE
110
106
POWER TO DEVICE
SELF POWERED MOTION DETECTOR
150
RESET
POWER DOWN TIMER
115
TIMER
105
120
PROXIMITY DETECTOR
IR DETECTOR
151
YN
YN
INHIBIT
125
130
135
140
145
AUTOMATIC POWER-UP POWER-DOWN CIRCUIT
100

Figure 1

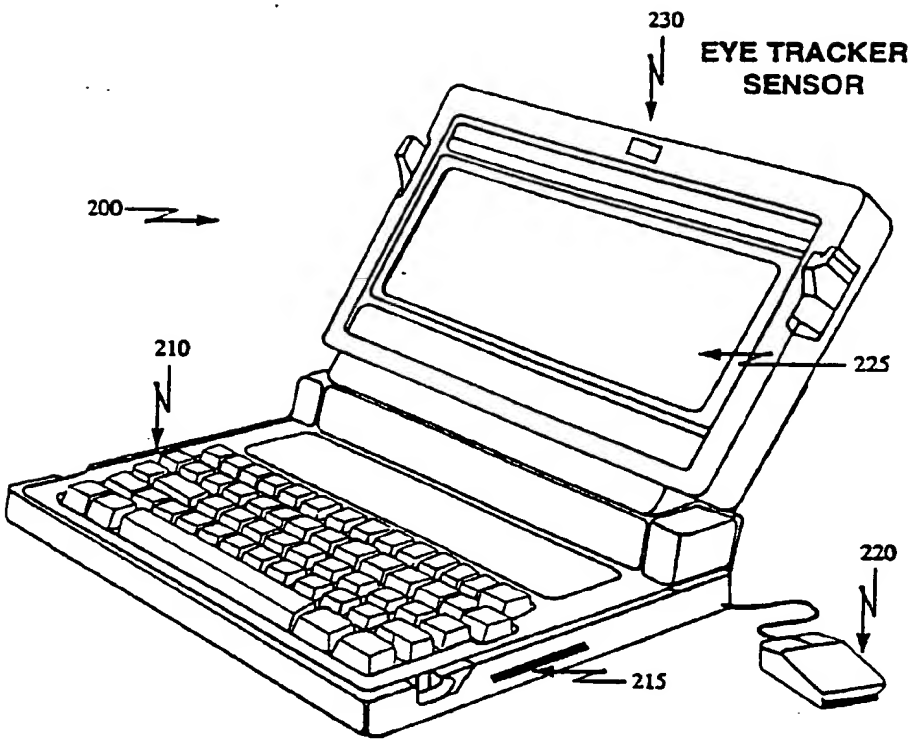

Figure 2A

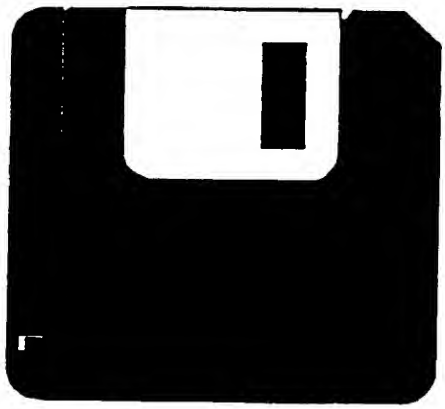

Figure 2C

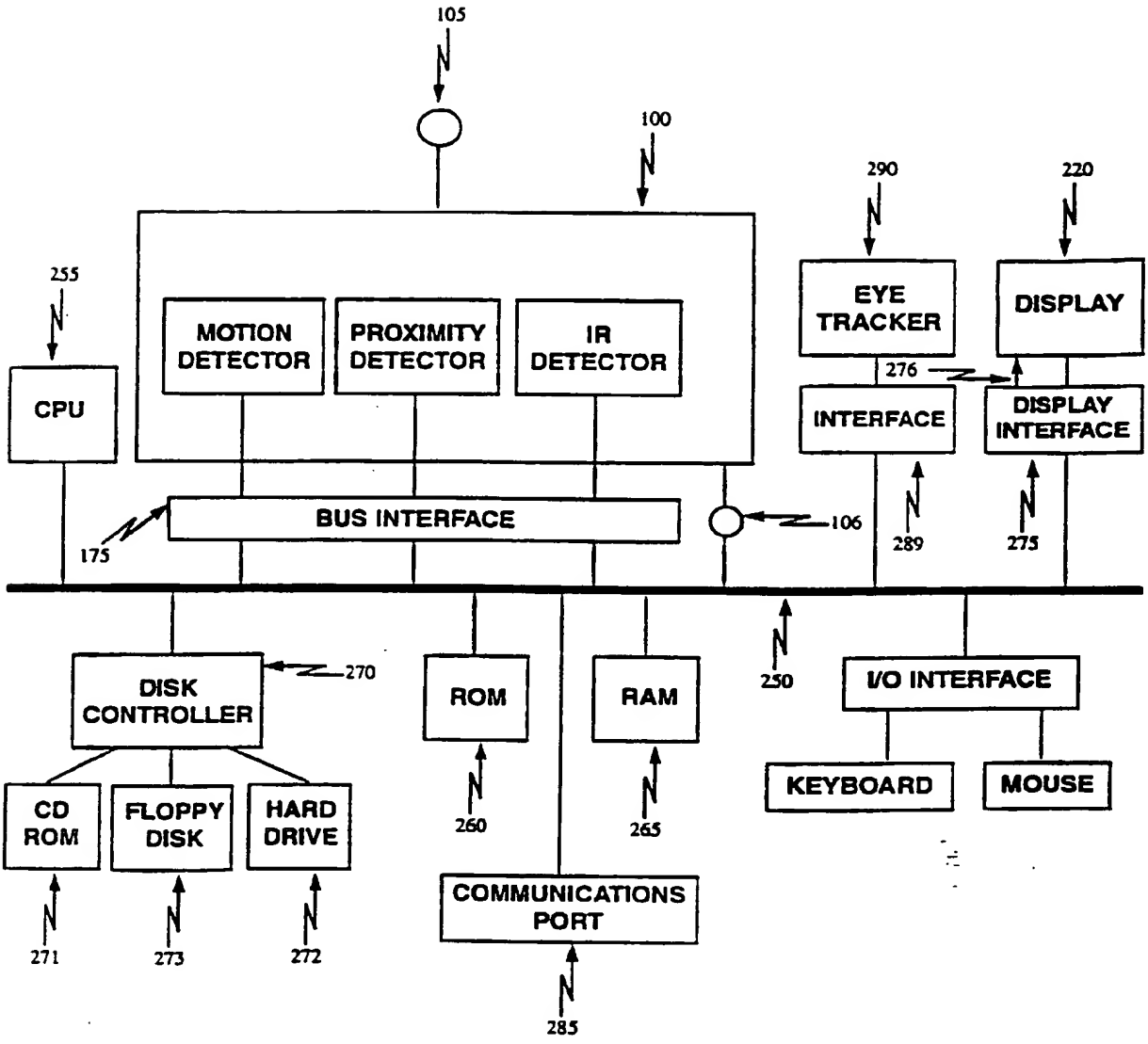
105
100
290
220
255
MOTION DETECTOR
PROXIMITY DETECTOR
IR DETECTOR
EYE TRACKER
DISPLAY
CPU
276
INTERFACE
DISPLAY INTERFACE
BUS INTERFACE
106
289
275
175
DISK CONTROLLER
270
ROM
RAM
250
I/O INTERFACE
KEYBOARD
MOUSE
CD ROM
FLOPPY DISK
HARD DRIVE
260
265
COMMUNICATIONS PORT
271
273
272
285

Figure 2B

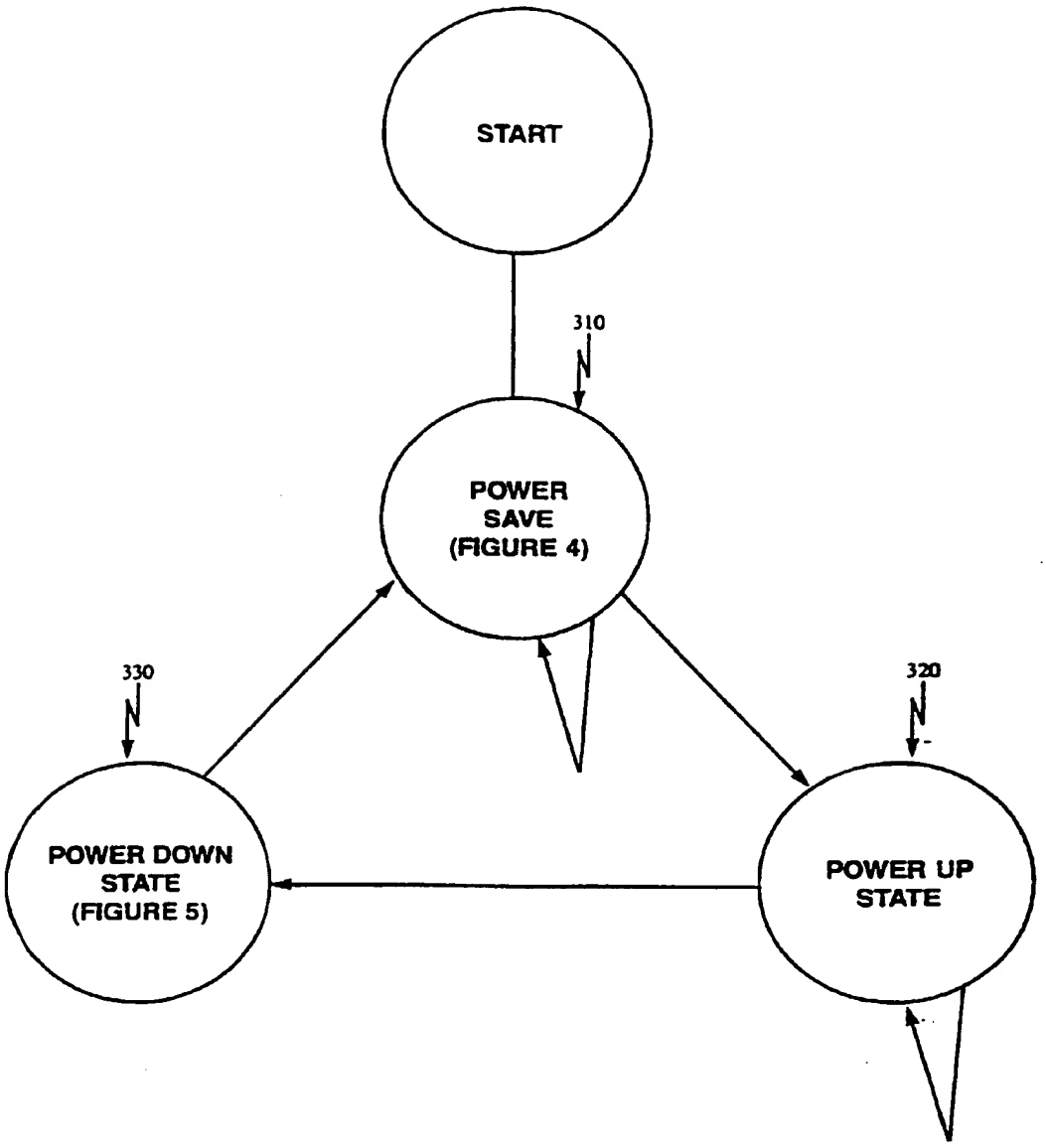
START
310
POWER SAVE (FIGURE 4)
330
320
POWER DOWN STATE (FIGURE 5)
POWER UP STATE

Figure 3

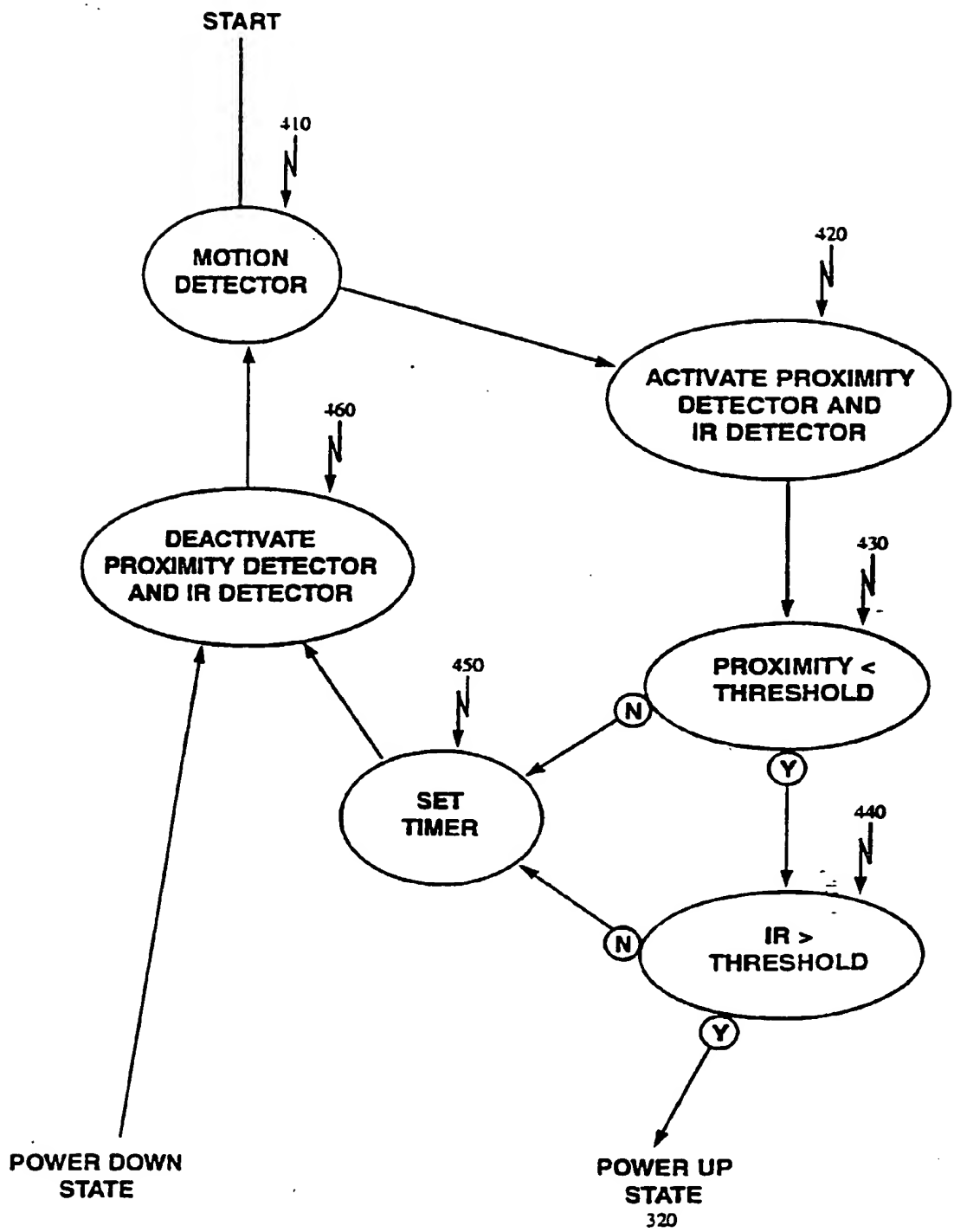
START
410
MOTION DETECTOR
420
ACTIVATE PROXIMITY DETECTOR AND IR DETECTOR
460
DEACTIVATE PROXIMITY DETECTOR AND IR DETECTOR
430
PROXIMITY < THRESHOLD
450
N
SET TIMER
Y
440
N
IR > THRESHOLD
Y
POWER DOWN STATE
POWER UP STATE
320

Figure 4

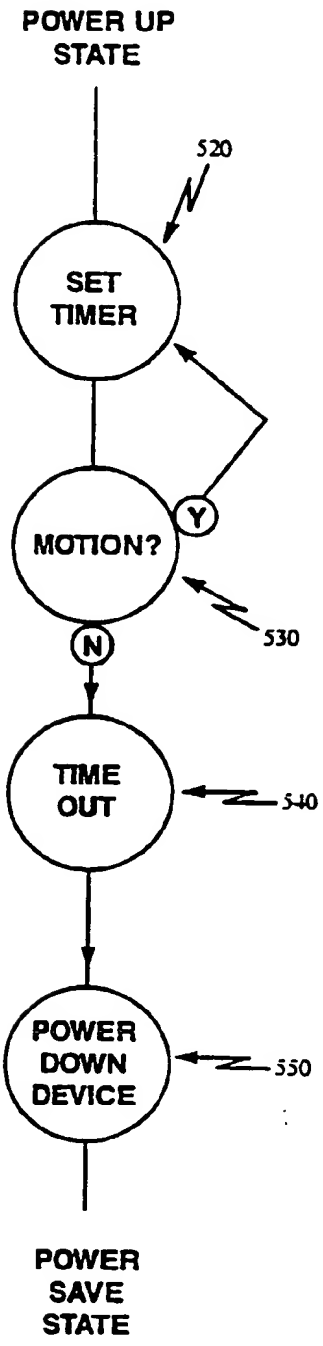
POWER UP STATE
520
SET TIMER
MOTION?
Y
530
N
TIME OUT
540
POWER DOWN DEVICE
550
POWER SAVE STATE

Figure 5

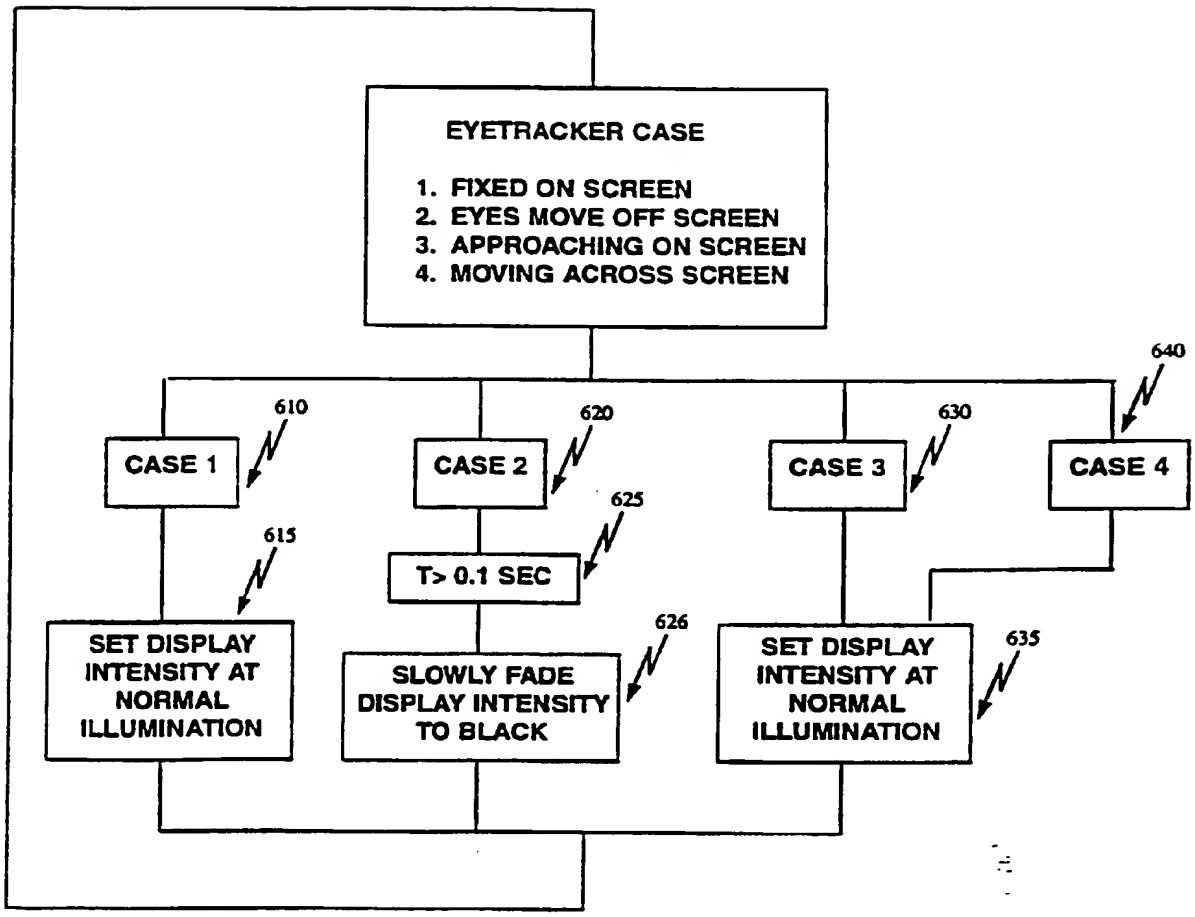
EYETRACKER CASE
1. FIXED ON SCREEN
2. EYES MOVE OFF SCREEN
3. APPROACHING ON SCREEN
4. MOVING ACROSS SCREEN
CASE 1
CASE 2
CASE 3
CASE 4
610
620
630
640
615
625
626
635
T> 0.1 SEC
SET DISPLAY INTENSITY AT NORMAL ILLUMINATION
SLOWLY FADE DISPLAY INTENSITY TO BLACK
SET DISPLAY INTENSITY AT NORMAL ILLUMINATION

Figure 6

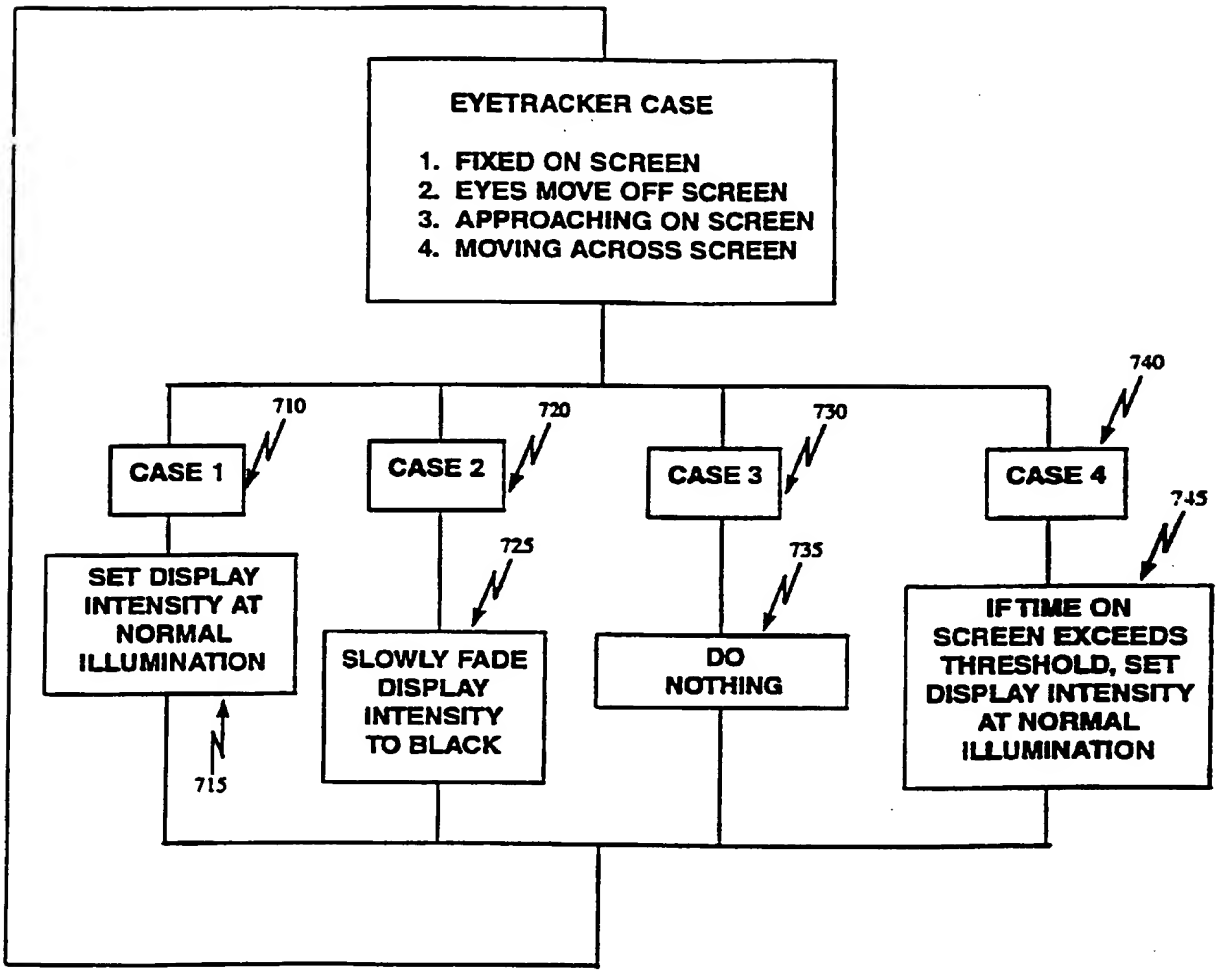
EYETRACKER CASE
1. FIXED ON SCREEN
2. EYES MOVE OFF SCREEN
3. APPROACHING ON SCREEN
4. MOVING ACROSS SCREEN
710
720
730
740
745
CASE 1
CASE 2
CASE 3
CASE 4
725
735
SET DISPLAY INTENSITY AT NORMAL ILLUMINATION
SLOWLY FADE DISPLAY INTENSITY TO BLACK
DO NOTHING
IF TIME ON SCREEN EXCEEDS THRESHOLD, SET DISPLAY INTENSITY AT NORMAL ILLUMINATION
715

Figure 7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 30 3620

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	IBM TECHNICAL DISCLOSURE BULLETIN, vol. 37, no. 9, 1 September 1994, page 121/122 XP000473354 "ULTRASONIC MOTION SENSOR FOR DISPLAY MONITOR POWER SAVING" * the whole document *	1-3,16, 20,24	G06F1/32 G06F3/00
A	IBM TECHNICAL DISCLOSURE BULLETIN, vol. 36, no. 8, 1 August 1993, pages 343-345, XP000390248 "PERSONAL COMPUTER ENVIRONMENTAL CONTROL VIA A PROXIMITY SENSOR" * the whole document *	1-24	
A	EP 0 622 721 A (ADVANCED MICRO DEVICES INC) 2 November 1994 * column 2, line 54 - column 4, line 25 *	1-24	
A	US 4 836 670 A (HUTCHINSON THOMAS E) 6 June 1989 * the whole document *	1-24	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
P,A	DE 296 10 766 U (SCHLOSSER MARIO) 9 January 1997 * the whole document *	1-24	G06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15 September 1997	Nygren, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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